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ABSTRACT

This study features an annotated bibliography of journal articles that emphasize the use of computers in the art curriculum. The annotations are grouped into four categories: technology in the classroom; restructuring school for educational technology; the impact of technology; and preparing for the year 2000. The study also includes background on the study, a glossary, a summary, conclusions, recommendations, and a bibliography. (DB)

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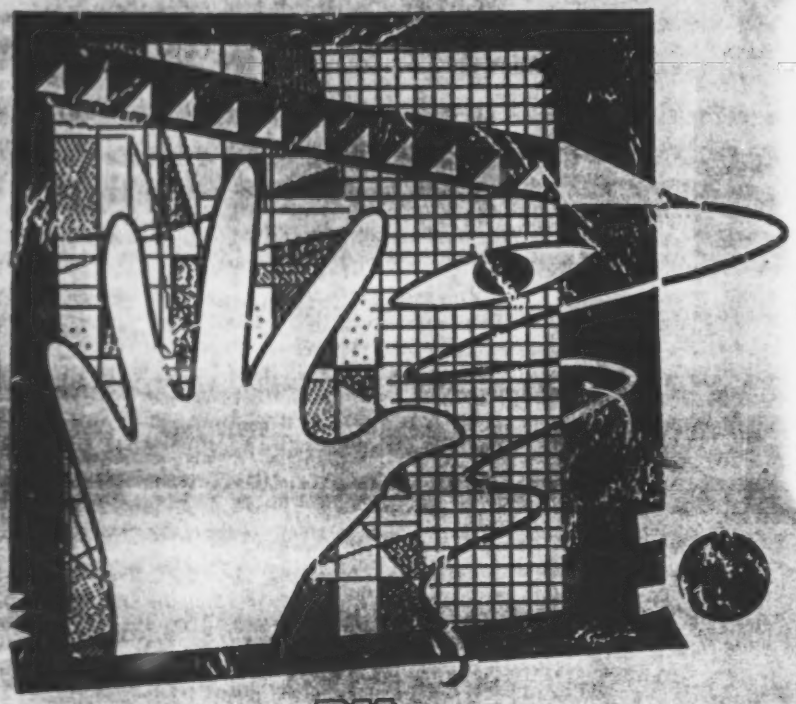
AN EXAMINATION OF TECHNOLOGY IN THE ART CLASSROOM: AN ANNOTATED BIBLIOGRAPHY



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BY:
MARYBETH LEBO
GRADUATE STUDENT

**

STUDY DIRECTED BY:
CHARLES R. DUVALL, PH.D

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AN EXAMINATION OF TECHNOLOGY IN THE ART CLASSROOM

An

Annotated Bibliography

By

Marybeth Lebo

Graduate Student

Study Directed by

Charles R. DuVall, Ph.D.

E591 Exit Project

Indiana University at South Bend

June, 1992

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INTRODUCTION

A common problem facing today's educator is keeping up with, and adjusting to, the rapidly changing world of computers. Computers have been used extensively in creating graphics, particularly in business and industry, and for some years computers have been used in cinematography and television for the creation of graphics and animation. Yet their use by artists as tools for creative expression has been limited due to the cost and availability of equipment used to generate such images.

In the past few years, however, the cost of computers has decreased, and development of software and peripherals has been significant. Many artists, even those accustomed to the traditional tools of art, have discovered computers and have begun to explore their potential for creating new visual images. Works created on computers can be seen in galleries and museums throughout the country. The computer has become both a tool and a new medium for the creation of art (Gardner, 1984).

In art education, the outlook is not quite as optimistic. Whether for political, economic, or personal reasons, computers have not found their way into most art rooms. The progressive art educator needs to keep abreast of this field. Although many have noted the potential of computers as an art tool, few art educators have incorporated computers into their art curriculum. Watt (1983) has found that: "Artists, software developers,

psychologists, and educators speak glowingly of the potential for computers and creative expression" (p. 78). "At the same time, Watt could not identify one example of using a computer in an art class as part of the regular curriculum" (p. 78). While there has been experimentation with computers in art rooms at higher levels of education (Cunningham, 1984), little has been done in elementary, middle schools, or high schools.

While there is validity to these observations, if art educators are to remain effective educators, they must realize the impact of computers, not only on society, but on the world of art as well.

STATEMENT OF THE PROBLEM AND PURPOSE OF THE STUDY

One of the most exciting ways computers touch our lives is through their ability to display graphics. Using computers to make pictures is becoming common in many fields, from the arts and architecture to medicine and satellite weather forecasts. Clearly, graphics dominate the video games of today. Now graphic applications are spreading through business and education and arriving at the front door of the art departments.

The purpose of this study was to organize research and information from sources that emphasized use of technology in the art curriculum and examine the number of educators that have incorporated computers into their art rooms, connecting art with computer graphics. It was believed that by examining the research and opinions of experts in the field of computer art education, new computer teaching strategies and philosophies would be applied in the classroom to transmit an openness of ideas and experiences in using computers in the creation of visual art images. The computer revolution has come to the arts. It's time to get ready.

LIMITATIONS OF THE STUDY

There was a vast amount of literature and opinion available, which advocated an increase in computers in general education. More research must be done in the area of developing a curriculum and the importance of technology in the visual arts. Due to time limitations, this study was an overview of the available literature. The lack of current research in curriculum development and implementation has limited this study.

ORGANIZATION OF THE STUDY

The study was divided into four areas. The first section dealt with technology in the classroom. The second explored the restructuring of schools for technology. The third section further emphasized the contributions technology has made in art education. The fourth section dealt with "preparation for the year 2000." Art educators must update curriculums to futurize needs of society so that art education will hold a more prominent position in the future.

GLOSSARY

aesthetics--"the theory of the artistic or the 'beautiful'; traditionally, a branch of philosophy, but now a compound of the above, aesthetics is no longer solely confined to determining what is beautiful in art, but now attempts to discover the origins of sensitivity to art forms and the relationship of art to other phases of culture..." (Good 1973:181).

aesthetic experience--"deep involvement or intense reaction to a work of art" (Ragans 1988:357).

art--"human activities aimed at the accomplishment of or participation in aesthetic experience; in common usage, activities that involve creative ability, ingenuity, judgment, and skill, resulting in an object or artifact" (Good 1973:40).

art education--"instruction and practice in the visual and spatial arts, as carried on in the schools: frequently recognized major areas are fine, industrial, graphic, and theater arts; specific visual arts include drawing, design, color, construction, history of art, and art appreciation" (Good 1973:40).

artistic style--"way of expression shared by an individual artist or a group of artists" (Ragans 1988:357).

creativity--"the process of rearranging concepts and

emotions in a new form, and it is also the ability or the disposition to do so" (Lansing 1976:28,29).

color--"element of art derived from reflected light. The sensation of color is aroused in the brain by response of the eyes to different wavelengths of light. Color has three properties: hue, value, and intensity" (Ragans 1988:358).

compact disc--"generally refers to five-inch (CD-ROM) that are read by laser beam. Most people are familiar with digitally recorded audio CDs. Similar discs are also used in CD-ROM drives for computers and can hold a great deal of information" (Images of Potential 1990:20).

composition--"arrangements of elements in a work of art" (Ragans 1988:359).

computer--"to compute, to determine by calculation" (Websters 1938:169).

computer synthetic voice translation--"refers to the technology of converting text into artificial speech using a computer. Also known as voice synthesis" (Images of Potential 1991:20).

design--plan, organization, or arrangement of elements in a work of art" (Ragans 1988:359).

desktop publishing--the capability of using computers and

laser printers to combine text and graphics into publication-quality documents" (Images of Potential 1990:20).

elements of art--"basic visual symbols artists use to create works of visual art. The elements of art are line, shape, form, space, value, color, and texture" (Ragans 1988:360).

fiber optics--"a bundle of many glass fibers that transport light across the length of the fibers. Computer data and phone conversations can both be carried through these fibers" (Images of Potential 1990:21).

history of art--"as a school subject, the study of an organized body of materials dealing with art expression through the ages, with specific periods or schools of art in their relation to the general development of art, and with the lives and works of artists having historical significance, such a study being undertaken with a view to increasing and enriching the student's appreciation of art works, whether old or new, and to supplying him with an historical perspective by which to see and understand better the current tendencies in art" (Good 1973:283).

language of art--"(1) is expression that conveys concepts and emotions; or (2) is expression that symbolizes concepts and emotions" (Lansing 1975:33).

laser disc/videodisc--"the 12-inch discs which are read by laser on a videodisc player. Each side of these large discs may hold 54,000 frames of information in the form of still pictures, text, graphics, or full motion video/film segments" (Images of Potential 1990:21).

modem--"a 'computer telephone' which converts information generated on a computer into tones that can be transmitted over telephone lines" (Images of Potential 1990:22).

multimedia--"the use of more than one technology to develop a presentation, lesson, or production. Possible combinations include computer with text and animation, videodisc player, CD-ROM player, synthesizer, and so on" (Images of Potential 1990:22).

overhead projection panel--"connected to a computer and placed on an overhead projector, this device allows a computer user to display 'live data' on a large film screen" (Images of Potential 1990:23).

robotics--"the technology related to machines that can be programmed to do physical tasks or activities, such as manipulating materials, tools, and special devices" (Images of Potential 1990:23).

scanner--"a machine which can 'read' the dark and light images of a document (text or graphics), and convert

them into digitized information which can be seen and used on a computer" (Images of Potential 1990:23).

VCR--"video cassette recorder, allows users to record and play videotapes on a television screen" (Images of Potential 1990:23).

visual arts--"the arts that produce beautiful objects to look at" (Ragans 1988:375).

Marcus, Aaron. "Graphic Design for Computer Graphics: Implications for Art and Design Educators." The Computing Teacher April 1984: 59-61.

Marcus gave an overview of visual communication through computer graphics. The principal research tasks of this article were:

1. Outerfaces
2. Interfaces
3. Innerfaces

Each of the three faces presents a different kind of graphic communication challenge in the area of computer art.

Marcus cites Dr. Beverly J. Jones: "The task of individuals trained in the arts and humanities is to ask the question about the nature of the new technology and its relation to human needs and values to determine appropriate modes of development and application." (The Computing Teacher, December 1980, p. 46-47.)

One of the complex processes to be examined was the study of new developments in computer hardware and software. Marcus states "that art educators can expand art and design study to include examination of computer graphics display." (p.61)

Marcus discusses the nature of visual communication as an essential part of the visual-verbal dialogue between the computer and the user. He also states that the professional skill and conceptual orientation of the art educator can affect the appearance of the three faces of computers in many ways. Educators of computer systems all must acquire awareness of, and some practical skills in, graphic design.

The author concludes that those educators who create, produce and use computer-based learning environments of the future must acquire sensitivity to the value of systematic non-verbal communication.

Semrav, Penny. "Computers: Art Chips in Education." Art Education May 1983: 4.

Written by a professor of the Department of Art Education, Ohio State University, this article describes the advantages of students experiencing first-hand computer use. Of particular concern was the means by which the study of technology on art can be traced back to the Industrial Revolution. Another concern was that teachers and parents worry about students' increasing inclination to turn to computers rather than to books and traditional learning systems. The author states "that the advent of the computer in art is merely another phase in this evolution. Computers are still no match for the wondrous neural capacity of the human brain, but each day brings advances which make the comparison less incredible." (p.4)

This article was guest edited by Dennis White of the University of Houston. White and a diverse array of writers have brought a great sense of complexity to the computer revolution and to the change it brings to the art profession.

Trotter, Andrew. "Technology in Classrooms: 'That's Entertainment!'" The Education Digest January 1992: 3-7.

This article was a study based on Texas, whose State Board of Education allowed school systems to use state textbook funds to buy videodisc-based curriculums. Another state featured in the study was California, who plans to allow electronic curriculum products to compete against textbooks.

The study also stated that within two decades schools with the money and desire will be able to present almost an entire curriculum electronically. The author labels computer education as "edutainment" and cites Eugene F. Provenzo, a University of Miami professor of Education, as saying, "schools are facing a confusion between education and entertainment; it has to be sorted out." (p.4)

Provenzo concludes that educators teaching computer technology properly require a tremendous amount of skill, and knowledge in large quantities.

Neil Postman, a New York University professor of Media Ecology, says, "it's easy to cross the fine line between using entertainment to underscore curriculum content and replacing that content altogether." (p.5)

A survey of 600 teachers by the Center of Technology in Education at the Bank Street College of Education found that as teachers become more familiar with computers, teachers use them less for drill and practice and more for word processing and data bases. The percentage of teachers who use computers frequently for enrichment and drill declines slowly with years of experience. Instead, over the next six years, teachers will increasingly use computers to create their own products, explore computer programs on their own and explain ideas or demonstrate skills.

Provenzo and Postman concluded that "what's needed now is a similar sophistication in drawing the line between entertainment and education, between the electronic media and the printed word." (p.7)

Peterson, Charles. "A National Institute: New Technology/ Assistive Technology and the Arts." Arts and Activities May 1992: 57.

This study was conducted with education professionals from California, Florida, the Midwest, Montana, Pennsylvania, and Japan. Art educators, artists, speech and language pathologists, administrators and computer users joined together to learn new techniques in providing creative access to the arts.

"New Technology/Assistive Technology and the Arts", the first institute of its kind, was presented as part of St. Norbert's Young Artist Workshop (YAW). (p.57) The institute was first to bring together art, special education, and technology. The program agenda featured five keynote addresses by national leaders on new applications of technology. The speakers included Dr. Guy Hubbard, Jeff Moyer, Dr. Dale Taylor, and Dr. Gregg Vanderheiden.

Hands-on workshops conducted by exhibitors provided opportunities to experience creative applications of new technology. The institute emphasized the accessibility of the arts and challenged artists, educators, and therapists to provide opportunities for creative expression to disabled students.

Eisner, Leslie. "What's a Picture Worth?" Classroom Computer Learning September 1985: 64-67.

Written by a professor on the Faculty of Education at McGill University in Montreal, this article describes the process of choosing computer generated programs suitable for kids.

There are ten important aspects to look for when purchasing a program for the classroom:

1. Easy Menus
2. Drawing Modes
3. Line
4. Shapes
5. Magnify Mode
6. Cut and Paste
7. Color
8. Text
9. Ease of Editing
10. Printing routines

In summary, graphics programs provide students with examples of how the computer can be used as a creative, artistic tool. "Regardless of which graphic program is selected, the ease of artistic creation is sure to capture the interest of the young at heart." (p.67)

Ettinger, Linda, and Uptis, Rena. "Talk About Teaching Computer Art Graphics." The Computing Teacher October 1983: 16-18.

Written by an instructor of the Department of Art Education, University of Oregon, this column examines what three specialists say concerning the use of the microcomputer in teaching art graphics.

Issue number one reported that students were all willing to spend time on projects and reflected the culture of each student.

Issue number two was headed by Ken O'Connell, the Director of the Fine Arts Department at the University of Oregon. O'Connell reported that through his observations, the computer will appear in most art programs in two ways:

1. As part of a general art history/appreciation curriculum; and
2. As as art medium.

Issue number three examined a pilot program where the unit of instruction revealed attention to several content areas such as:

1. Art history;
2. Technical skill development; and
3. Critical analysis.

The column concluded that the following components are essential in designing a computer graphics curriculum:

1. Rationale describing the significance of computer art graphics;
2. Overview outline presenting the main concepts;
3. Objectives for teaching and evaluating; and
4. Lesson plans.

Peterson, Charles. "Accessing the Arts Through Assistive Technology." Arts and Activities May 1992: 28-29.

This article is an overview of the project YAW (Young Artist Workshop) which is a year-round multifaceted program of continuing education workshops for educators, as well as experiential arts opportunities for the developmentally disabled. The Arts Access project explores the use of computers and augmentative communication systems to access both visual and performing arts by students who are non-vocal, physically challenged or multi-handicapped. The author, Charles Peterson, director of YAW, and Charles Frame, a technology specialist with Wisconsin Public Schools, initiated a program to develop and test the use of augmentative communication equipment and to release the results of the research nationally.

Researcher Frame is convinced the Arts Access program has unlimited potential. "Assistive technology enables students to express and experience their talents for the first time with new forms of language--the visual and performing arts." (p.29) The YAW began in 1985 as an experimental summer arts program for 20 students with physical disabilities and/or communication disorders.

Edwards, John. "Getting Into Apple Graphics." Popular Computing May 1982: 64-70.

Written by a freelance writer based in New York and a frequent contributor to Popular Computing, Edwards focuses on three of the most interesting graphics editors and what they can do for the classroom.

Edwards recommends a computer slide show using "Painter Power" as it allows the students to create so much more than a conventional paint set and canvas.

Another recommendation to classroom computer graphics is Sirius Software E-2 Draw. This program allows much more ambitious students to draw outlines and shapes with an extremely fine degree of control. E-2 Draw literally takes the computerist by the hand and guides the way to the making of various shapes and outlines.

In addition, Edwards concludes with a final software named "Bill Budges 3-D Graphic System." This program creates a three-dimensional graphics system for producing animated graphic sequences. The scope and length of this report provides a wealth of material on the study of computer graphic softwares.

Hubbard, Guy. "Exploring Electronic Expression." Arts and Activities May 1992: 34-35.

Hubbard gave an overview of the purposes and foundations of computer art. "Because of the profound impact of this new art form, art teachers need to open the eyes of students to the qualities inherent in computer art." (p.34)

The author represents four very different styles of computer-generated art by:

1. M. C. Escher;
2. James Watkins;
3. Kenneth Snelsons; and,
4. William Latham.

In view of the increased availability of computers in schools, the artists featured may further open students' eyes to the potential for creative expression in students' own computer graphics.

Mueller, Robert. "When is Computer Art Art?" Creative Computing January 1983: 136-144.

Mueller stated that "educators must conclude that anything goes in modern art, because the norm seems to be that there is no norm." (p.136) Aristotle, Tolstoy, Kant, and Susanne Langer asked: "What, after all, is art?"

In 1976 Mueller wrote an article published, "Art In America," which attempted to apply years of training as a visual artist to the efforts of computer specialists in pictorial graphics. Mueller cites philosopher William Barret who feels art educators suffer from "the illusion of technique" which is the overuse of technical computerized equipment. Barret states that, "art educators must be highly critical of what educators call art when it comes from a computer." (p. 138)

The specific problem addressed was how art can be computerized in the future. The process studied involving computer graphics was to confront students with the unaccustomed task of detecting techniques in computer use. Mueller argues that, "Educators should exert caution when calling computer graphics 'art'. There is a vast world of simple reproduction or pure design which is not art, although very interesting and original." (p. 144)

This study underscores the complexity of art versus computer graphics.

Clements, Robert. "Adolescents' Computer Art." Art Education March 1985: 6-8.

In this article Clements advocates the use of computers for the making of art by adolescents. The author states that by 1986, 40% of all microcomputers will be equipped with color and graphics software. Clements cites Thomas Linehans' 1984 column, "Computer Applications," where up-to-date information can be accessed on new technologies suited to art programs for schools.

Clements provided sound facts, cases, and analysis to support his judgment that "Principals and superintendents must be convinced of the art teachers' need for computers, and teachers of other subjects must be convinced of the art teachers' rights for students fair share of computer time and access." (p.8) In addition, Clements concludes that "The biggest obstacle to initiation of computer art in schools is neither the computer, school curriculum, nor class sizes. It is ourselves." (p.6) The teachers' will to have a computer graphics program is most important to an art curriculum.

Greh, Deborah. "Using Computer in Secondary Art Education." The Computing Teacher November 1986: 4-8.

This paper is a sharing of Greh's experiences and observations in establishing and teaching a high-school course in computer art. Greh provides an overview of comuters and art education.

In this study Greh cites Watt, 1983, saying "Artists, software developers, psychologists, and educators speak glowingly of the potential for computers and creative expression." (p.5) Greh presents extensive research on a number of art educators who have encouraged the use of computers in an art curriculum. Clark, Hubbard, and Linehan, 1983, have suggested that the computer be used as a classroom manager and/or as a tutor of art history and aesthetics. Another educator, McCulloch, 1984, envisions the role of the computer as an aid to instruction, a managerial aid, and a tool for creating art. It is only recently that art educators have focused on exploring the potential of computers for use as an art medium. (Boling and Hubbard, 1983)

In establishing a high-school computer art course, Greh found that students approach their works using various thinking skills. "The students saw their work as a medium and approached their work with a daring freedom not easily available with more traditional media. The computer provided students with opportunities to experiment and use the elements and principles of art with their own ideas." (p.9)

Hubbard, Guy and Greh, Deborah. "Integrating Computing into Art Education: A Progress Report." Art Education May 1991: 18-24.

The Special Interest Group on Computer uses in Education (SIGCUE) sponsored a meeting in June, 1989, to consider the problem of what pre-service teachers in art needed to know about computing by the time of graduation. Assembled at the meeting were specialists in the area, where each were assigned to prepare a position paper about computing. The meeting was addressed by Director Robert P. Taylor. The outcome of these efforts are published in a special issue of Outlook.

The purpose of their article was partly to inform art educators of the most recent initiative by SIGCUE. The results of this project fell into two domains:

1. Certain knowledge is the domain of the subject of Art and belongs in courses taught by Fine Arts faculty. Two areas of study appeared to belong to Fine Arts, namely:
    A. Computer applications that lead to the creation of art; and
    B. Aesthetic understanding about computing when used as an artistic medium.
2. Certain knowledge is the domain of Art Education and should be taught by faculty in that area. Four areas appeared to belong to Art Education.
    A. Knowledge about hardware and software suitable for arts programs;
    B. Applications of computing that advance the teaching of art;
    C. Ways in which computers need to be managed for use in art rooms; and,
    D. Ways in which computers may be used to integrate art studies with those from other areas of the curriculum.

Alesandrini, Kathryn. "A Look at Computer Graphics." The Computing Teacher February 1985: 23-25.

The author states that according to research results (Dwyer, 1983), pictures don't have to be realistic or lifelike to be instructional. This article is an overview of research based on making learning fun by using colorful graphics.

Alesandrini explored the general theory of graphic art in the classroom and conveys three types of graphics:

1. Representational;
2. Analogical; and
3. Abstract.

Another requirement for ensuring the educational merit of computer graphics is that the graphics should always reinforce and enhance learning rather than reward mistakes and failure. Using such graphics make lessons both fun and educational.

Alesandrini gives one example called "Green Globs," a program designed to teach graphing (Dugdale and Kibbey). Green Globs and programs like it provide an educational experience that is not feasible with traditional educational methods. Using computer graphics can both motivate and teach.

Kerlow, Isaac. "The Computer as an Artistic Tool." BYTE September 1984: 189-196.

Kerlow gave an overview of the purposes of the computer as an art tool. Kerlow outlines the methods used to create computer art and the general concepts behind it, focusing on images of three-dimensional environments and objects created by mathematical models and databases, particularly those in a three-dimensional space.

The panorama of computer art changed greatly during the seventies with the development of techniques for representing three-dimensional environments and the increased involvement in art. Computer-based imaging became more interactive and easier to use.

Recent computer art is complex and full of various styles, techniques and attitudes. The author investigates the CARTOS system which is flexible and extremely effective. The CARTOS system can reconstruct and simulate three-dimensional objects from two-dimensional data. Researchers at Columbia University have been developing this system since the early seventies. CARTOS was not designed to be an artist's tool but to help science and biologists. In future years this program will be implemented as an artistic tool and will be used in art curriculums for research.

Isaac Kerlow is a freelance graphic designer for Byron Preiss Productions. He teaches seminars on digital typography for microcomputers in the Computer Arts Forum. His work was exhibited in this publication and has appeared in several other studies.

Freedman, Kerry. "Possibilities of Interactive Computer Graphics for Art Instruction: A Summary of Research." Art Education May 1991: 41-47.

This paper was written by a professor on the faculty of the Art Education Program at the University of Minnesota. This paper provided a framework for speculating on the production process, social dynamics, and the forms of computer-assisted school art.

The research referenced suggests that technical and conceptual peculiarities of the technology, and certain hardware and software should be taken into account when developing curriculum. Research done on the use of computers in the context of art classrooms is very important. The author researched the following three issues that pertain to the use of interactive graphics hardware and software in schools:

1. Computer graphics production processes;
2. The social dynamics of computer graphics production in school; and
3. Qualities of computer graphics imagery.

The author cites Marshall and Bannon, 1986, in their research of an elementary school. Half as many of the fifth-grade girls used computers at home as did boys. When given a choice of activities with computers, boys chose to design or play computer games. Girls preferred to use computers for a wider variety of purposes, such as writing letters or making a birthday card. Of the fifth-grade boys, 24.5% reported that they learned how to use computers on their own; only 5% of girls said that they learned how to use computers without help.

It was reported that both boys and girls tend to collaborate more when making art on a computer than during other classroom activities. Two conclusions accounted for these differences:

1. Boys initiated their own experiences with computers, whereas girls rarely did; and
2. Girls generally got more attention from adults in learning how to use computers.

Gender differences were also illustrated by both the subject matter and structure of student work.

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Levinthal, Cyrus. "The controversy in Computer Art." BYTE September 1984: 198-206.

This report included an introduction to the controversy of computer art. Levinthal focuses on the issue of the original in computer art. This issue in computer art also brings up the relation between art and technology, the identity of the artist, and the visual language used.

Levinthal feels that "understanding the relation between art and technology is necessary to understand the aesthetic values of computer art." (p.198) The report tracked how different technologies throughout history contributed tools and methods for the development of artistic projects. Artistic creation in the Renaissance period would not have been possible without the technology for fabricating colored pigments, brushes, and canvases. Without technology, Levinthal states that "many of the events that occurred at the turn of the century would have gone unrecorded. Computers are the latest entry in the historical development of imaging technologies."

Levinthal cites various researchers who contributed to this study. Levinthal concludes that the computer is a contemporary tool and its use for the creation of images opens possibilities in the field of artistic creation. The computer brings challenges and problems on all creative levels, aesthetic and technical, to students, educators, and artists.

COMPUTERS IN ART EDUCATION:
RESTRUCTURING SCHOOL FOR EDUCATIONAL TECHNOLOGY

Brown, Cheryl. "Mixed Results." NEA Today April 1991: 5.

On the subject of computers, the author stated that "one of the keys to reform is technology, but technology as a tool, not a goal." (p.5) Brown described model school districts and how they used technology to imnplement restructuring. Brown cited the 1989 NEA Committee on Education Technology to enrich educators' lessons and student learning.

Marshall, Gail. "Evaluating Research on School Computer Use." The Education Digest January 1989: 30-33.

Marshall stated, "as more technology is introduced in classrooms, more research on its effect on student achievement is demanded." (p.30) More research on computer use in school shows evaluating sloppily and too soon. Marshall emphasized that the benefits of technological innovations should not be judged so quickly, often not until after the second year. Marshall cited "Bits and Pieces," an article in which computers are used for evaluation of achievement in school curriculums. The author contended that a trustworthy computer study does more than recite goals, summarize training, and present and analyze data.

Ettinger, Linda, and Roland, Craig. "Using Microcomputers in the Art Curriculum." Art Education January 1986: 48-51.

The authors present an overview of ways microcomputers can be incorporated into existing comprehensive art curriculum. It should be noted that teachers can learn to assist in understanding how programs work.

Bolognese and Thornton (1983) have written a book describing the possibilities of the computer in the art classroom. The authors list six study areas designed to help students gain insight into the unique aesthetic potential of the microcomputer as an art medium:

1. Interactive art;
2. Pattern generation;
3. Animation;
4. Sound integration;
5. Random images; and
6. Artifact construction.

Computers were used as early as 1964 to create imagery that was primarily aesthetic (Davis, 1973; Peterson, 1983). Technology of computers has advanced at a very rapid rate, and indeed, there is a history of the use of computers in art.

The use of microcomputers in an art class often involves students in technical exercises rather than investigation of aesthetic issues. Teachers must carefully analyze students and school settings before developing a computer curriculum.

Hannum, Wallace. "Reconsidering Computer Literacy: Is It A Basic Skill?" The Education Digest January 1992: 8-11.

On the subject of computer literacy, arguments still arise. Hannum drew from a recent research that studies have failed to find a positive effect of computer courses. In a national survey of teacher expertise with computers, only teachers in high socio-economic schools scored over 30 on a scale of 100; most teachers lacked significant computer expertise. Accumulating evidence fails to support that the teaching of computer programming enhances problem-solving. Students rarely get to work with updated software. The result in schools today is that computers are more available but good software is lacking. Students rarely get enough time on a computer to become proficient.

Today computers are becoming easier to use. There is a broad misunderstanding and overestimation of the demand for employees who are sophisticated in computer use. Projections are that only 7% of all new jobs during this decade will be in high-technology areas. Estimates of the demand for computer programmers are for 30,000 annually, representing only a small portion of the 40 million children in school today who are the target for computer literacy courses.

Hannum explains that "computers may be a means of improving our teaching but computer literacy as a subject does not equate to the academic subjects being taught to students." (p.11)

Madeja, Stanley S. "Computer Graphics: The New Subject Matter for the Art Curriculum." Art Education May 1983: 15-17.

Written by a professor of studio art at Arizona State University in Tempe, this article describes new technology and suggests applications to the art programs in schools.

Madeja describes two methods of creating the video image:

1. Conventional line method; and
2. Pixel screen method.

Both methods offer students a range of techniques to creat images. Madeja cites A. Michael Noll (1983) in an introductory essay to the Siggraphy '82 Art Show where he discusses the future of computer art as a "creative partner" with the artist/student, yet many computer art programs have not caught the fancy of the art school curriculum.

Many art curriculums can absorb the content and methods of new technology. Teaching in the visual arts needs content to keep pace in the latter part of this century.

Research and development of curriculum at all levels is needed, and teacher education and in-service programs must reflect this. Art educators need to organize and teach technological visual language now and in the future.

Ray, Doris. "Removing Barriers of Social Organizations in Schooling so Technology Can Aid Restructuring." The Education Digest January 1992: 14-17.

Ray discussed the 18-month research project she set up to better understand how technology relates to school restructuring. Ray emphasized six strategies that could help implement restructuring with technology:

1. Respect fundamental importance;
2. Develop creativity and vision;
3. Improve the notion of leadership;
4. Increase access to technology;
5. Support research and development; and
6. Build a technology infrastructure.

Ray felt that technology, by itself, would not restructure schools; but schools could not restructure without technology.

The restructuring of schools is essential to effective use of technology in education. "It is impossible for schools to venture very far in the future without the tools for survival in the environment." (p.17)

Mecklenburger, James A. "Restructuring our Schools for Educational Technology." The Education Digest January 1991: 52-55.

The author stated that "we need to view education in the context of the technologies of America in the 20th and 21st century." (p.52) For a nation who demands a 21st century education system, only 20% of school employees will reap the benefits of technology use. There are more than 45 million students in private and public schools; students outnumber available computers by 40 to 1.

Mecklenburger cites "A Nation at Risk," a study which outlines average student credits earned in various subject fields 1982-87. The study shows computer courses slowly increasing. Mecklenburger concluded that "Education that relies on electronic learning is the future. Making changes happen, sensibly and for the good of the nation, is the restructuring task of the 1990's that educators have yet to consider." (p.35)

McCulloch, Dr. W. "A Change of Image: Computers in the Art Room." Art Education July 1984: 44-46.

Written by a state art consultant for the State Department of Public Instruction, this article states that the age of electronic education is not coming, it is here; and the use of computers is now a top priority of the education establishment. "The majority of art educators share one of two attitudes concerning the use of computers in the classroom. One is that computers are fine, but serve no purpose in art and, the other is that computers are so impersonal that they could be the death of a good creative art program." (p.44)

McCulloch conducted research to substantiate those two points. His research found that, essentially, computers serve students' educational needs in three ways:

1. As an aid to instruction;
2. As a managerial aid; and
3. As a new art tool.

McCulloch feels it is time for art educators to take an active role in shaping the future of education at the local levels. Educators will have to readjust their thinking and methodology to accommodate a new body of knowledge. Artists have been recognized as an innovative force within society. Schools today have come to view art educators as innovative teachers.

Maddux, Cleborne D. "Integrating the Computer into the Curriculum: The Need for Caution." Computers in the Schools, Haworth Press, Inc., 6 (3/4) 1989: 31-37.

Written by a professor and department chairman of curriculum at the University of Nevada, this article states that one of the newer fashions in educational computing is the advocacy of curriculum integration.

To make computers available so that one machine is in every classroom would require the dismantling of all public school computer labs in the country, and the redistribution of the computers. This conclusion comes from examining data from the most current report on the state of the art in educational computing. This report was published by the Office of Technology Assessment (OTA) (1988) on the past, present, and future impact of technology in education. It reveals that there is only one computer in schools for every 30 public school students.

The report concludes that if current funding continues, public schools can expect no more than little access to technology and that the vast majority of schools don't have enough computers to make them a central element of instruction. Recently, the OTA reports that 25% of student teachers say they feel minimally prepared to use computers in their teaching. Another likely cause is that states have been slow to require educational computing courses prior to certification. The OTA report identifies only 18 states that require preservice technology training. Maddux believes that state departments of education must require at least one computer education course, colleges of education must institute their own computer education graduation requirements, and school districts must offer quality inservice programs.

Educators need a more prudent approach to the controversy that is forming around the issue of curriculum integration.

Selfe, Cynthia. "Re-Defining Literacy: The Multi-Layered Grammars of Computers." The Education Digest January 1992: 18-21.

Selfe discussed the fact that the use of computers as communication aides can affect creative literacy in two ways:

1. Computers add new grammars to programs; and
2. Computers change the way text is seen.

Selfe cites Gail E. Hawisher, co-author, "who feels our work is cut out for us. Educators will have to diligently work to identify and explore the changing nature of creativity and literacy within a computer-supported environment. Educators must do this even as the computer industry continues its explosive growth." (p.22)

Computer labs are best to work in because the labs offer opportunities for both research and teaching. In computer labs, educators can observe changing demands on students, gather evidence, develop strategies, and test the strategies on a variety of populations.

Pearlman, Robert. "Technology's Role in Restructuring Schools." Electronic Learning June 1989: 8-9, 12-14.

The computer movement essentially has not transformed schooling in America. To its credit, in the 1980's it has produced a large and vibrant community of technology-using educators to play a role in discovering and disseminating information on how technology supports the restructuring of schools.

Pearlman states that there are over 2 million computers in U.S. schools, as the Office of Technology Assessment study reports. The experience since the early 1980's of injecting enormous amounts of technology into schools seems to validate the "George Leonard Thesis"--that technology alone does not produce change.

Two definite changes suggested to re-design schools by both Chiron and Saturn planners are:

1. Students should be enabled to become "active educational workers"; and
2. Teachers must be given resources and training needed to invent and re-design the schooling process.

Technologies can empower teachers to do their work and to envision the ways in which schooling can be redesigned. Technology implementation, by itself, will not change schools; but it can support teachers in designing student learning activities where students become "active educational workers." Teachers would then expand their role from the front of the classroom to becoming facilitators and coaches of student learning.

Bruder, Isabelle. "Restructuring Schools Through Technology." The Education Digest May 1991: 7-9. (From "Business Week", Dec. 10, 1990)

Bruder warned that schools must fundamentally change the way they operate to excel as society moves on to the information age.

Bruder cites Linda Roberts of the Office of Technology Assessment as saying, "Technology is not, nor should it be, the pivotal factor in restructuring." (p.7)

The article described Kentucky schools which have allocated 1.3 billion dollars for the first two years of its educational reform. The use of technology in Kentucky is being tied to addressing educational needs.

Other states are restructuring to different degrees. Michigan is giving nearly 18 million dollars worth of computer systems to about 8,000 of its teachers this year.

Many districts restructure to accomplish new things, not simply to duplicate with technology what can be done on paper.

The conceptualization of using technology in education needs to change.

Swartz, Theodore F. "Finding Funding for the Computer Project." Classroom Computer Learning March, 1984: 36, 39, 41.

This article was adapted from "How to Fund a Computer Project," a chapter in Educator's Complete Guide to Computers by Theodore F. Swartz, Stephen M. Shuller, and Fred B. Chernow, Parker Publishing.

The article gives an overview on identifying major funding sources. The Educational Consolidation and Improvement Act of 1981 significantly changed sources for public funding of educational projects. Private funding sources are foundations that provide institutions with financial support for educational activities. Using the Foundation Directory is a way to identify private funding sources.

Swartz states that one way of locating active funding organizations is to talk with local schools, districts, and education agencies. Swartz also lists six ways in which to locate these groups:

1. Read relevant materials;
2. Attend relevant lectures;
3. Join organizations;
4. Conduct an ERIC search;
5. Obtain a copy of the microcomputer directory; and
6. Solicit advice from sources.

Securing funding for computer education projects may entail some hard work, but major funding sources can make the task a little easier.

In addition, the Department of Education has several grant programs that could be relevant to funding a program. Money for these grants is allocated to individual states.

COMPUTERS IN ART EDUCATION:
THE IMPACT OF TECHNOLOGY

Freedman, Kerry. "Computer Graphics, Artistic Production, and Social Processes." Studies in Art Education March 1992: 33 (2), 98-108.

Freedman conducted a study which indicated that descriptions of computers as either controlling student imagery or just another art medium are inadequate. Three group trends resulted from this study:

"A. There was a general shift during the learning process from a focus on production to ideation in the students' responses about image development and learning processes;

B. The students' images developed interactively in both production and ideation, indicating the students both controlled the computer and the computer influenced changes in their images and ideas; and,

C. The social interactions among students were important to computer graphics development and to learning processes." (p.108)

Freeman states that "the shift from a focus on production to the ideation responses indicated that, as students learn more about graphic production and develop more control of the computer, they focus more upon ideas." (p.108)

Phelan, Andrew. "The Impact of Technology and Post Modern Art on Studio Art Education." Art Education March 1984: 30-36.

Phelan's main contention was that art teachers should pay close attention to what is happening in the art world and what may be happening, because their future will be affected.

Phelan points out that there are four major impacts on studio art education:

1. New aesthetic to post-modernism;
2. Expressive new tools;
3. Use of Computers; and,
4. Alternatives to the current gallery structure.

The four play a large part in future teaching of studio art.

Phelan reflects on the past decade in the art world citing the Bauhaus which established itself as the dominant influence of the 20th century in art education. The author believed that "in an age of new technology and the post modern (post-Bauhaus) age, educators must rethink the basic studio art curriculum." (p.36)

The teaching of art will drastically change when computer art becomes a major aesthetic force. Phelan states that "If drawing is no longer such a basic skill, then the long-established primacy of drawing must be reconsidered for a curriculum." (p.36) The author cites Kim Levin and Iwing Sandlers writings on aesthetic styles stating "modernism has become problematic." (p.30)

While it is not certain what the future needs of educators will be, art education will be asked to meet those needs. "Alternative computer use may indeed be the place in which the future of art education makes itself first visible." (p.36)

Linehan, Thomas E. "Computer Graphics: Opportunity for Artistic Vision." Art Education May 1983: 11-14.

Linehan stated that computer graphics are used to cover four principal areas of investigation:

1. Data analysis;
2. Data synthesis;
3. Data manipulation; and,
4. Pattern recognition.

Linehan cited the research of R. R. Gross (1969). Gross argues that a simulated human may be beneficial in it's interpretive value of the computer interface.

Linehan also cited R. Arnheim (1969), "While there may be some support for the claim that the computer is anthropomorphic in its design, some gestalt psychologists would argue that there is a vast difference between human intelligence and machine intelligence." (p.11)

Linehan emphasized the relevant role computer graphics will have in establishing new art curriculums. Additional applications for computer graphics are being constructed in the area of interactive videodisc learning games (Linehan, 1981; Stets, 1981; Stredney, 1982). (p.14)

Linehan concluded that "Picture making by computer is here to stay. Art educators can help shape both the quality and direction that picture-making takes by engaging in research and development by proposing inventive applications to one field." (p.14)

Adams, Dennis and Fuchs, Mary. "The Fusion of Artistic and Scientific Thinking." Art Education November 1985: 22-24.

The authors stated "As far as art is concerned, schools increasingly view it as a type of personal participatory therapy, rather than as a discipline worthy of its own integrity." (p.22)

As the educational system focuses on a narrow range of skills, computer-controlled technology is starting to be built on a broad base of the humanities. Science and the visual arts are coinciding. Today education is reaching towards a new liberal arts that incorporates technology. Computers, like the Apple MacIntosh are beginning to make use of skills drawn from a broad band of the visual arts. Today's technology is changing the way we think about ourselves.

The authors feel that "Technology will fuse with visual, artistic and musical movements." (p.22) What educators teach is very different from the skills needed for the present and the future. The relationship of computer-controlled visual images to the traditional visual arts has yet to be explored. The authors cite artist Nancy Burson of the Federal Bureau of Investigation, "Artists and educators are using technology to explore new ways of relating images and print." (p.24)

Art is being used to increase teaching of science through graphics. Through technology, educators can amplify both art and science. The authors state, "To participate in the world, technology and the humanities must be linked so that sound communication takes place." (p.24)

A type of art and humanities instruction that nurtures creativity and deepens educators' understanding of the world will increasingly come into play as society moves to understand technology and the future.

Hoelscher, Karen. "Providing Meaning and Power to Education." Computers in the Schools May, 1990: 5-6.

The author cites Paulo Freire, "The Power of Education" (p.5) indicating "Education alone cannot do everything. It provides a reason for us to identify its limit. Once limits are defined something can be done about them." (p.5) This, Freire believes, gives both meaning and power to education.

Hoelscher states that there are two limits:

1. Limits of traditional teaching methods; and,
2. Limits of various technologies.

By breaking down the two limits educators are better able to identify the strengths of each.

Hoelscher describes her work with Howard Law School where she participated in a recent evaluation of video disc. The disc was designed to address a limitation of the traditional legal education curriculum, providing students with practical case development skills. The conventional curriculum, via lectures and written cases, provided requisite skills for students in legal methods; the videodisc provided an interactive environment affording practice of these skills in a simulated client-attorney relationship. This combination, according to the faculty and students involved in the study, gave new "meaning and power" to legal education. (p.6)

"Meaning and power" has brought four new learning environments to education. They are:

1. To build creative learning environments where children and teachers have immediate access to technology;
2. To study how these environments affect teaching and learning;
3. To document and share results with parents, educators, policymakers and technology developers; and,
4. To use findings to recreate the vision.

Hoescher states, "Four years of observation and research in 'ACOT' (Apple Classrooms of Tomorrow) across the United States reveal that learning activities in which technology is most powerfully used, engage students in tasks they perceive as real work with real purpose." (p.6) In such activities, students do create, and interact with peers, teachers, and technology.

Kerr, Jim. "Toward an Inviting Computer Classroom." The Computer Teacher August/September 1990: 26-27.

The focus of this report was "the use of computers and experiences for the future." (p.26) The author finds that "when educators reflect on technology, educators become defensive and deny the possibility that the computer may actually be a useful tool." (p.26).

The author offers the following tips to facilitate an inviting technological atmosphere:

1. Electrify the introduction of the course;
2. Explicitly state learning objectives;
3. Enhance instructional routines;
4. Provide a glossary;
5. Condense instruction;
6. Turn students loose;
7. Monitor progress;
8. Don't pamper;
9. Hands off; and
10. Evaluate.

The author cites Purkey and Novak (1988) ("Education: By Invitation Only"). Both authors state that, "Techniques for the computer should be designed to provide a rewarding and intentionally inviting atmosphere." (p.26) All components should be plainly visible and well defined when technology is in use. Expectations of computer use increase the learning environment remarkably.

Roland, Craig. "Our Love Affair With New Technology: Is the Honeymoon Over?" Art Education May 1990: 54-60.

The major premise of Roland's research was restricting students to one approach to the computer, noting that it can prevent greater learning experiences. Roland felt the need to move beyond lessons which regard the computer as merely an extension of older art forms, to studies which examine the qualities of the art medium.

Microcomputers first gained recognition in the field of art education in the early 1980's. Recent estimates place over 1 million microcomputers in U.S. classrooms. Computers are being used in a variety of subject areas at all levels of instruction. Roland cites Clements and White (1985) who feel, "The most frequent practice in art classrooms is for students to work on microcomputers with graphic peripherals and user friendly application programs that enable them to simulate drawing and painting on the computer screen." (p.54)

Throughout the article, Roland outlines computer imaging, computers as an interactive machine, and computers as a time machine. He cites S. Wilson (1986) for his work, "Computerized Street Events" (p.60) which exposes the computer's increasing involvement in human interactions. Students then can explore the interactive capabilities of computers in art by writing programs that require spectator participation.

Roland states, "The future holds the promise of rich interchanges between the worlds of art and technology." (p.60) "Art teachers can take advantage of this link by developing innovative approaches to the computer that help students gain insight into a versatile role as an art medium." (p.60) The computer must be seen as a viable partner in the art curriculum now and in the future.

Wilson, Kathleen. "New Tools for New Learning Opportunities." Technology and Learning April 1991: 12-13.

The focus of this article is based on an article Wilson wrote for Apple Education News. The author quotes John Dewey, "To what avail is it to win prescribed amounts of information about geography and history, to win ability to read and write; if in the process the individual loses his own soul...if he loses his desire to apply what he has learned and, above all, loses the ability to extract meaning from his future experiences as they occur." (p.12)

Dewey's views are no less important today, in a world bursting with easily-accessible information and rapidly-changing knowledge. Wilson pointed out that adults of tomorrow will need to be skilled at accessing, filtering, and managing such multidimensional information.

Interpretive skills such as problem solving, creative thinking, and a sense of open inquiry are becoming more important than ever.

Wilson cites that great developmental educators--Dewey, Bruner, and Piaget, "all agree that children learn best by doing and creating." (p.12) When used properly, multimedia environments can allow children to learn by manipulating both visual and symbolic information.

Multimedia environments can't replace good teachers. These environments must be integrated into the learning process as one more tool from which teachers and students may draw.

Multimedia environments will provide students who interact with them a sense of excitement about discovery--a crucial ingredient of learning. The author paraphrases Dewey's (1938) Theory of Learning as "The most important attitude that can be formed is that of a desire to go on learning." (13.)

Helmick, Richard. "Enhancing Creativity in Art and Design through Stochastically Generated Computer Graphics for the Future." Art Education July 1984: 36-39.

The focus of this report was Helmick's proposal that computers could be used by artists and designers to help simulate creative processes.

The author cites Leonardo da Vinci (1452-1519), "Artists must seek inspiration in random occurrences and select ones that suit their purpose." (36) Such practices encouraged artists to look freshly at their own work and to prevent artists from falling into cliches.

Helmick relates that designers and artists who use stochastic processes in making aesthetic decisions with computers in the classroom may promote, simulate, and enhance human creativity.

The author cites artists Jackson, Pollock, Kolomyjec, and LeCorbusier for their intensified work with stochastic processes and the computer in art. Helmick documented historical examples to illustrate the fact that computers and art have a lengthy relationship, reaching back to the 1500's.

Helmick indicated that students could use computers as an aid to aesthetic decision-making in an artist-like manner. The significance of computer art is that students, designers, and artists use stochastic processes in making aesthetic decisions, which are useful to simulate and enhance human creative endeavors.

Hubbard, Guy. "Computer Literacy and the Art Program." Art Education March 1985: 15-18.

The focus of this report proposes ways by which elementary and secondary art educators can begin using computers in art programs, thus participating in a major new thrust in education.

Hubbard cites Barbour (1984) who says, "Twenty states have already introduced computer literacy requirements for graduation." (p.15) To meet requirements and to satisfy local demands for more than minimal literacy, schools must develop courses and programs in computing at all levels K-12.

According to Hubbard, "Computers in schools can be divided into two categories:

1. Computer literacy; and,
2. Software.

Hubbard identified four modes: computer literacy; ghaphics; programming; and art by instructors; as significant elements in the approach to a computer art class.

The author contended that, "Many art educators support computer-based education, but the task of persuading a school establishment to permit art teachers to become equal partners in computer education is not likely to be easy." (p.18)

Hubbard concluded that, "We can only hope to reach more of the school population than we do at present and show art to be truly at the heart of the curriculum." (p.18)

Squires, William. "Creative Computers: Premises and Promises." Art Education May 1983: 21-23.

Squires states that artists and art educators are adapting expectations to a creative future of computers and software. The use of computer systems in the studio art classrooms calls into question matters of professional ethics and academic freedom.

Squires argues that, "Computer advocates believe their computers can behaviorally duplicate and reflect the artist's creative capacities." (p.21) Squires also feels that equating computer behavior with human creativity treads on shaky ground.

Many advocates of computer art argue that everything man does involves some sort of behavior which, in turn, computers can approximate.

Squires drew from the literature of researchers and educators in computer art to help verify that once a commitment has been made to technology, it becomes difficult to get rid of it in the classroom.

COMPUTERS IN ART EDUCATION:
PREPARING FOR THE YEAR 2000

White, Dennis. "Art Education within a Technological Society." Art Education May 1983: 6-7.

White outlined the work done by Guy Hubbard and Thomas Linehan in the areas of future computer technology. Hubbard suggests in his article, "Arcade Games, Mindstorms, and Art Education" that computer technology may find "appropriate application in three essential areas, namely: instructional delivery; evaluation and testing; and, curriculum management." (p.7) In combination, the authors have presented a solid foundation of the manner in which these new capabilities may be used to enhance attainment of those educational objectives the profession may deem desirable.

White establishes the tenor of his article by presenting a historical perspective of the difficulties involved in coming to grips with rapid technological advances.

White's arguments clearly illuminate potential areas of concern as our society moves to fully embrace computer technology.

Dede, Christopher J. "Educators Take Hold of the Future." Electronic Learning January 1990: 8-9.

Dede relates that into the next millennium rapid advances in information technology will be the most important trend shaping education. The article focuses on how educators can anticipate and shape emerging developments in instructional technology.

Dede states that there are four misconceptions that have contributed to educators' passive attitudes toward emerging instructional technologies:

1. Misconception of consolidation;
2. Misconception of literacy;
3. Misconception of power; and,
4. Misconception of timing.

Transcending these four misconceptions is vital to the advancement of instructional technology.

The author cites strategies that educators can use to anticipate and shape emerging developments in instructional technology. They include:

1. Monitoring literature in technology;
2. Tracking computer-supported cooperative work, "The Journal of Artificial Intelligence in Education, Hypermedia, and AI and Society" can aid in this scanning effort." (p.9);
3. Inviting experts to speak on technology at educators' conferences;
4. Extensive briefings on long-term direction; and,
5. Forming buying collectives that produce a set of specifications for advanced applications.

Dede cites "The Technology Initiative of the National Foundation for the Improvement of Education" (p.9) as an example of such projects.

The author indicates that the 1990's will be a difficult time for American society. Americans need to see if innovations in technology can play a role in helping alleviate some of the major educational problems that persist within education today.

"Educators must develop sophisticated approaches that at least double educational effectiveness by changing to a technology-intensive paradigm of teaching/learning." (p.9)

White, Dennis W. "Advanced Technology, Art, and Art Education: Reaching Towards the Third Millennium." Art Education May 1983: 8-10.

White states that to meet the challenge thrust upon educators, art education programs have to take full advantage of those enlarging artistic and educational boundaries offered by the emerging technologies of our time and in the future.

White contends that technology perhaps is best classified as originating from 1852 when Martin Corterrile, a Frenchman, developed a programmable organ. (Frank, 1981, p.16) "This almost fragile effort to gain extended control over the machinery of man put in motion a movement that would culminate nearly a century later, in 1946, with the first modern operational computer." (p.9) Exactly thirty years afterward, microcomputers, able to be placed comfortably on an average-sized desk, and infinitely more powerful than their early predecessors, were introduced to the American population.

The author cites S. Pogron's theory that the profession must assume the responsibility of ensuring instructional programs of "technological relevance"--programs designed to address the realities of merging technologies which are seriously blurring distinctions between that which is conceived of as art and that which is the domain of science. (Pogron, 1982, p.610)

In light of these requirements, White stated that, "The central core of all educational programs needs to be restructured to accommodate the computer as a major instructional component." (p.10) White states that, "Computer literacy must be raised to the status of an expected educational outcome if art education programs are to be effective within the environmental setting of the next millennium." (p.10)

Kurshan, Barbara. "Creating the Global Classroom for the Twenty-First Century." Educational Technology April 1991: 47-50.

Kurshan's main contention is that the growth of telecommunication networks and projects is changing the image of the classroom for the 1990's. The global classroom as it evolves will be connected by networks that reach across the globe. By the year 2000, each classroom will include diverse communications, including computers, videos, CD-ROMS, and satellite access. Students, teachers, and parents in the global classroom will learn from each other and together will solve problems.

Kurshan points out that it is now estimated that the total knowledge of mankind currently doubles every 7-8 years and that over 2,000 books are published daily. These figures continue to accelerate and do not reflect the impact technology has on the production of knowledge. Moreover, the rapid developments in technology are changing our society from one based on raw materials to one based on human knowledge and skills for problem solving.

Kurshan emphasizes the growth of global classroom projects and their implementations have become a point of focus for the education restructuring movement. "Educators today are aware of the need to develop a new vision of education for the twenty-first century and are using technology to assure that students will have skills." (Kurshan and Resta, 1989) (p.47)

Kurshan outlines a variety of issues:

1. Network organization;
2. Group tasks;
3. Opportunities for response;
4. Online obligations; and,
5. Evaluation methodologies.

In addition to these issues, the author cites Wulf and Rosenberg's developed term "collaboratory" concept, which is a composite of collaboration and laboratory in the classroom. This is a place in which students interact with technology.

Kurshan states that the development of a pedagogy for teaching in the global classroom is in its infancy. Many traditional methods are being adapted to the new technologies. Many new ideas such as the collaboratory, are evolving as global classroom projects.

In the next few years, researchers will need to help practitioners develop and test structures for the effective implementation of global classrooms.

Kuhn, Marylou. "The Relevance of Art Education to the Future." Art Education April 1967: 5-7.

Kuhn states that a particular problem of the future will be adjusting to the means for relating and maintaining values which put a premium on individual effort and accomplishment to an environment of enlarging resources and interdependent systems of technology through the arts.

The position of art education is fluid and uncertain in relation to itself and to the current pressures of contemporary times. Art education must look onward to technology in the classroom. The author states that, "Art education must determine whether it will be a part of this onward technological thrust or whether it will say that art is of another nature." (p.7)

Kuhn outlines that to learn skills for a new technology is the answer. Art cannot function as in the past in this era of technology.

Kuhn cites Manuel Barkan, "Art education today is in the midst of change...The present scene already presages some of the potentialities of the future, and...whatever positive promise the future may hold can only be realized through the critical examination of much that is assumed to be right, proper, and sensible." (p.7) The author states that technology in the classroom is a valuable resource for students.

Goodson, Bobby. "Looking into the 1990's." Teaching and Computers September 1989: 18-20.

Goodson explains that over the past year, discussions about technology in the classroom have begun to develop with national debates about education and the teaching profession. A consensus seems to be growing around two points:

1. Citizens of the twenty-first century will need different kinds of skills than schools currently provide; and,
2. Teachers of the twenty-first century will fill different roles than they currently fill.

Technology has a large part to play in both of these transformations.

Goodson outlines the lessons of educational computings' brief history. Goodson cites the Report of the National Education Association's Special Committee on Educational Technology, published by the NEA Committee. This report reviews the status of technology in schools and offers recommendations for building on teachers' central role in successful use of technology.

The study further stated that, "A plan must focus on the individual educational needs of students and how educators meet those needs rather than on the technology as an end in itself." (p.19)

Goodson concluded that with "the help of state and national policymakers, with district, school administration and staffing working together with their communities, schools of the 1990's can become a reality in any community." (p.20)

Lanier, Vincent. "The Very Near Future." Art Education January 1976: 5-8.

The article states that art educators do not seem to be aware of the newest and most innovative technological devices available in the field, nor is the production of materials for these devices in adequate supply to suggest that awareness, interest, and experimentation will soon be forthcoming.

Lanier explained that the "Technology of education is recognized by art educators as a group and is being explored in its less revolutionary aspect." (p.8)

Lanier outlines problems art educators have with technology in the classroom:

1. Preoccupation with studio art;
2. Lack of concern with technology; and
3. Lack of concern with subject matter.

Lanier states that despite these serious, fragile barriers, there have been some signs that art education is becoming more responsive to developments in the technology of instruction.

Lanier cites "The Uses of Newer Media" project, sponsored by the NAEA, which is another new ferment of ideas in the field of art. Lanier further explains that an interesting illustration of our present readiness to accept new ideas in technology occurred during the September, 1965, seminar at Pennsylvania State University. Manuel Barkan read his paper describing a programmed art lesson for use in a computer. "He anticipated a protest at his mechanization; yet, no protest was formed." (p.6)

Lanier concludes that the newer technology can be of substantial value in the improvement of the quality of art education in our schools. "What is needed is information and imagination." (p.8)

BEST COPY AVAILABLE

Cetron, Marvin J. "Preparing Education for the Year 2000." The Education Digest April 1989: 3-6.

Cetron states, "The class of 2000, and their schools, face educational demands far beyond those of their parents' generation. And, unless they can meet those demands successfully, the United States could be nearing its last days as a world power." (p.3)

Cetron specifies eight major areas of improvement to bring high quality education to all members of the class of 2000:

1. Lengthen the school day;
2. Cut median class size from 17.8 to 10;
3. Computerize the classroom;
4. Tailor courses such as "IEPs";
5. Promote students based on performance, not on time served in class;
6. Recruit teachers from business and industry, not just from university educational programs;
7. Set new priorities for school systems that today are overregulated and underaccountable; and,
8. Bring internships to high school students not headed toward college.

Cetron cites The National Commission on Excellence in Education "A nation at Risk," stating that since 1984 "The Reagan Administration attempted to cut the national education budget by more than ten billion dollars. Though Congress always restored most of those proposed cuts, the federal government is spending, after inflation, about fourteen percent less for education than five years ago." (p.6)

According to Cetron, America needs "to enact all the reforms. It is up to concerned citizens, parents, and teachers to equip our children with the knowledge and skills necessary to survive and thrive in the twenty-first century. Time is running out: the class of 2000 is already with us." (p.6)

Kinnaman, Daniel E. "What the Future Holds." Technology and Learning September 1990: 43-49.

In this article Kinnaman states, "For better or worse we've left the 'industrial age' behind and are racing full-speed through the information age. Yesterday's science fiction is rapidly becoming today's reality." (p.43)

Kinnaman cites Dr. Robert Tinker of the Technical Education Research Center (TERC) who hopes to see the development of an international telecommunications network for K-12 education. The focus of this report was "make technology central to the curriculum." (p.48)

The author focuses on the Education Development Center, Inc., in Newton, Massachusetts, where the director Myles Gordon states, "For technology to contribute positively to education reform it has to become a fundamental part of what teaching and learning are about." (p.48) The EDC plans to continue to push toward inquiry learning and problem-centered curricula by taking advantage of advanced technologies such as different networks and hypermedia.

Two types of educational development are underway at EDC. The first involves developing curriculum and materials that will encourage and enable the effective use of current technologies by much larger numbers of teachers and students. The second is to contribute to the development of advanced technologies, opening new opportunities for teaching and learning. Both areas of development involve helping students "redefine the path they take through a new body of knowledge" says Gordon. (p.48)

Weiss, Stefanie. "For the 90's: A Computer on Each Teacher's Desk." NEA Today September 1986: 32-33.

The author discusses the possibilities of a computer and adequate software on the desk of each teacher by 1991. Weiss cites NEA's Secretary-Treasurer, Roxanne Bradshaw, who is calling on schools to provide the computers soon. "We've come to expect to see computers on the desks of all professionals, yet we haven't demanded that teachers who help train this country's professionals also have access to computers." (p.32)

Weiss reports that every teacher needs a computer--that the concept of a computer lab down the hall utilized by a few teachers is not applicable.

The focus of this article was technology as a means to restructure the school environment. In using computers, the author notes, the critical elements for the teachers are access, training, and time. The article states plainly that teachers now lack all three and makes the following recommendations to remedy the situation:

1. Classroom management software;
2. Access to computers for training;
3. Training during school hours;
4. Entry-level teacher computer knowledge; and,
5. Integration of technology into curriculum.

The latest step of NEA has asked major computer companies for proposals. By January, 1991, the Association plans to "endorse one or more systems to increase the number of computers in teachers' hands," said Gary Watts, NEA Assistant Executive Director for Professional and Organizational Development and Staff Liaison to the Technology Committee. (p.33)

Shane, Howard, G. "Improving Education for the Twenty-First Century." The Education Digest April 1991: 12-14.

"Improving education for the next century means rebuilding our schools for technology." (p.12) Shane feels that this approach was of great importance.

In Shane's view, redesigning schooling for students who will live all or most of their lives in the twenty-first century is certainly more essential than the swarm of current reform proposals related to improving out-of-date practices.

The author cites a report commissioned by the U.S. House of Representatives, "Information Technology and Its Impact on American Education," stating guidelines for planning educational policies that need to be developed to prepare learners to cope with a rapidly-changing world:

1. The age range of school educators;
2. Technological curricula;
3. Future-oriented school staff; and
4. More school days (10-11 months).

Shane states that school redesign will be unique for each school district, and there are no uniform practices followed by all districts. Shane specifies that "educators must not look for uniformity but for emerging programs that will help our oncoming generations defuse the socioeducational time bombs with which we are presently challenged." (p.13)

SUMMARY

Hubbard stated that, "because of the profound impact of this new art form, art teachers need to open the eyes of students to the qualities inherent in computer art" (Hubbard 1992:34). The most important benefits that computer art present are problem-solving, technical skill development, critical analysis, and creative skills.

Phelan, Freedman, and Bruder further expanded on how computer art education reflects a change that society has undergone. Dr. W. McCulloch greatly influenced the future practice in computer art education when he wrote that art educators share one of two attitudes concerning the use of computers in the classroom: one is "that computers are fine, but serve no purpose in art and the other is that computers are so impersonal they could be the death of a good creative art program" (McCulloch 1984:46).

Stanley Madeja examined the widespread influence that Hubbard had on computer art education and recognized a need for change. Madeja stressed the fact that, "the future of computer art can be a creative partner with the artist/student" (Madeja 1983:17). Therefore, he stressed a more structured technological setting and more inservice, teacher education programs for the professional.

Ettinger and Roland showed that as early as 1964 computers were used to create imagery that was primarily aesthetic. This is still evident today, yet some educators

give a false impression to the public as to the true value computers can hold in art education.

Freedman's study revealed public opinion in two ways: "computers as a control over student imagery" and "computers as just another art medium." These concepts enhanced the idea that computer art is only for the technologically talented. Freedman concluded that students and the public grew up experiencing these philosophies and, therefore, saw no true value to computer art.

The studies reviewed by Ettinger and Uptis revealed that the public is primarily concerned with reading, writing, and arithmetic and that many feel computer art does not hold a place of importance in the school's curriculum. Clements agreed with these studies, in that society is under tremendous pressures and, as a result, seeks a no-frills concept to education.

Semrav contended that, "the advent of the computer in art is merely another phase in this evolution" (Semrav 1983:4). Provenzo stated that, "schools are facing a confusion between education and entertainment" (Trotter 1992:7).

Today, schools find themselves using electronic curriculum products to compete with textbooks. Provenzo further stated that computer art is an indispensable condition of technological work in the arts and sciences and is a good functioning skill in practical life (Trotter 1992:4).

Peterson emphasized the integrative aspects of computer art in the classroom. Computer art combines problem solving, perceiving, and creating into an inseparable unit.

Computer art education, when approached from Alesandrini's view, is a challenging and educational subject. She stated that to ensure educational merit in computer art, one should always reinforce and enhance learning rather than reward mistakes and failures. Levinthal concurred with Alesandrini. Levinthal stated that, "understanding the relation between art and technology is necessary to understand the aesthetic values of computer art" (Levinthal 1984:206).

Hannum noted the importance of problem solving, analysis, and creative thinking in computer art. Alesandrini's theories were further supported by Selfe. She believed that the use of computer art could affect creative literacy. She also stated that computer art should be viewed as "exploring the nature of creativity"--as much as any other academic subject.

Computer art education complements the other academic subjects. As Weiss noted, "We've come to expect to see computers on the desks of all professionals, yet we haven't demanded that teachers who help train this country's professionals also have access to computers" (Weiss 1986:32). Watts agreed with Weiss' position, but further advocated that a computer-oriented course in graphic art be offered to every student. Indeed, Shane supported this

position by commenting that "Improving education for the next century means rebuilding our schools for technology" (Shane 1991:13).

There are many life-enriching aspects to computer art education that make it a worthwhile course of study. In another article, Kinnaman pointed out that, "For technology to contribute positively to education reform it has to become a fundamental part of what teaching and learning are about" (Kinnaman 1990:48).

Cetron noted that, "the class of 2000 and their schools face educational demands far beyond those their parents' generation faced" (Cetron 1989:4). With these demands, students are denied the personal and social developmental aspects of computer art.

Kuhn stressed that future art education must look to technology in the classroom as an aid in problem solving and decision making which helps the student in his private and academic endeavors. Hubbard discussed how computer art helped clarify the students' abilities to deal with ideas, problems, and approaches; and in so doing, increased their overall desire to learn.

Helmick expounded upon the nature of computer art and its related history, dating back to the 1500's. He felt that, "students could use computers as an aid to aesthetic decision making much in the manner used by artists" (Helmick 1984:37). Roland pointed out, "the need to move beyond lessons which regard the computer as an extension of older

art forms, to studies which examine the qualities of the art medium" (Roland 1990:55).

The future of computer art education relies on the fulfillment of three tasks:

1. Principals and superintendents must be convinced of the art teachers' need for computers;
2. Teachers of other subjects must be convinced of the art teachers' rights to a fair share of computer time and access for their students; and,
3. Communication to the public that computer art has a significant position in the general framework of education.

Computer art education has lacked a clear set of objectives by which it can be measured. As Clements proposed in his article, "the biggest obstacle to initiation of computer art in schools is neither the computer, school curriculum, nor class size; it is ourselves" (Clements 1985:6).

The establishment of standards will ensure computer art education a proper place within the general framework of education. These standards will foster the type of art curriculum that Brown advocated: a curriculum that offers problem-solving, perceiving, and creating (Brown 1991:5).

Phelan felt that, "extensive computer art use may, indeed, be the place in which the future of art education makes itself first visible" (Phelan 1984:36). With this, computer art would be perceived as a major aesthetic force

to the education of every student. Once computers and art have established a united position in the classroom, the perception of computer art education will improve.

Clark, Hubbard, and Linehan felt that art educators must emphasize that the computer can be used as a tutor of art history and aesthetics, for classroom management, and as a tool for creating art. Alesandrini emphasized the need for computer art education to be seen by the students as being educational, challenging and motivational.

Computer art can open many doors to the unique aesthetic potential of the microcomputer and the tools of the future.

CONCLUSION

The direction of the research clearly indicated that computer art education today is misunderstood and undervalued. The computer is seen as an expensive piece of educational equipment that need not be required for the art curriculum. Such stereotypes negate the idea that computer art should be considered a part of the academic course.

The study has shown that computers in the art classroom, as a technological course of study, aid in the development of problem solving, technical skill development, critical analysis, and creative skills.

It is now necessary to restructure and reevaluate the manner in which computer art is taught. Only then can computer art become an integral and valued part of the general curriculum in schools.

RECOMMENDATIONS

It is recommended that:

1. A computer art course be required of all elementary, junior-high, and high-school students as part of their fine arts study.
2. Training programs be developed for new and experienced teachers which will allow them to realize and utilize computer skills.
3. Programs be developed for school superintendents and principals which would expose them to the various computer graphic programs, thus increasing their commitment to computer art education.
4. Art curricula include not only the creation of art works, but also art history, art criticism, studio art, and computer art graphics.

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BACKGROUND

NAME: Marybeth Lebo

ADDRESS: 1005 Wright Ave.
La Porte, IN 46350

EDUCATION: B.S. in Art Education (K-12)
Northern Illinois University
DeKalb, IL, 1985

Graduate work toward a M.S. in Secondary Education with a professionalization in Art, I.U.S.B.

TEACHING EXPERIENCE: Art Teacher: grades 6-8
Boston Middle School, La Porte, IN, 1989-present

Art Instructor, Super Saturday for the Arts, La Porte School Corporation, La Porte, IN, 1989-present

Gifted and Talented Summer School teacher, La Porte School Corporation, La Porte, IN, 1988-present

Art Teacher: grades 1-5
La Porte School Corporation, La Porte, IN, 1988-89

Art Teacher: grades 6-12
Winamac School Corporation, Winamac, IN, 1985-88

INTEREST IN TOPIC: The topic will be of practical value in improving my computer art curriculum and in working with the other feeder programs within my school corporation.

STUDENT COMPUTER WORK